Based on the foregoing data, square planar geometry has been proposed for the complexes.

ACKNOWLEDGEMENTS

The authors are thankful to Prof. G. Aravamudan, I.I.T., Madras, for magnetic and thermogravimetric data. One of the authors (S. S. H.) is grateful to the University Grants Commission, New Delhi, for the award of Research Fellowship.

1. Mohan Katyal and Yag Dutt, *Talanta*, 1975, **22**, 151.
2. Umapathy, P. and Appala Raju, N., *Indian J. Chem.*, 1964, **2**, 248.
3. — and —, *Ibid.*, 1963, **1**, 272.
4. Krishna Reddy, Y., *Ph.D. Thesis*, S. V. University, Tirupati, India, 1969, p. 193.
5. Umapathy, P., Venkata Reddy, D. and Appala Raju, N., *Indian J. Chem.*, 1965, **3**, 471.
6. Nencki and Sieber, *J. Pr. Chem.*, 1881, **23**, 147.
7. Srihari, S. and Appala Raju, N., *Curr. Sci.*, 1978, **47**, 946.

A NOTE ON MAGNETISATION OF MAGNETITE-ORE BAND AT ADDATIGALA IN ANDHRA PRADESH

V. BHASKARA RAO AND A. LAKSHMIPATI RAJU
Department of Geophysics, Andhra University, Waltair

ABSTRACT

Remanent magnetisation of seven oriented samples from the magnetite-ore band at Addatigala (Lat. 17° 30′ 38″ N, Long. 82° 3′ 20″ E), East Godavari District, Andhra Pradesh, is studied. The NRM intensities of the samples range from $1{\cdot}6 \times 10^{-3}$ to $8{\cdot}7 \times 10^{-3}$ e.m.u. The samples are subjected to a.c. demagnetisation. the directions, after demagnetisation, are distributed around two different mean directions. The Declination (D) and Inclination (I) of the two mean directions are D =310° (E), I = + 25° and D = 36° (E), I = + 9°. Samples with differing directions are found to be different mineralogically also. In the samples with the first mean direction, the major ore mineral is found to be magnetite, while in those with the second mean direction, magnetite is found to be extensively martitised

INTRODUCTION

MAGNETITE occurs in the gabbroic rocks traversing the Eastern Ghat suite of rocks, garnet sillimanite gneisses, quartzites, leptynites, and charnockites (Sriramadas[1]) along the NE–SW shear zones in the margins of the charnockite belts (Karunakaran[2] and Narayanaswamy[3]). The magnetite ore at Addatigala is intimately associated with a sequence of ultramafic rocks comprising variants of pyroxenite, hornblende and plagioclase. It occurs as layers and lenses. The country rocks comprise garnetiferous granite gneisses, garnet-feldspar-sillimanite gneisses, reconstituted quartzfeldspar gneisses and schists, feldspar-sillimanite gneisses, charnockites and pink granites. The ore band trends at N 60° E with a dip of 60° SE The area is surveyed with a magnetometer for delineating the ore band and finding its extent and dimensions (Lakshmipati Raju[4]). Measurements to estimate the Natural Remanent Magnetisation (NRM) and magnetic susceptibility are made on collected samples of the ore. The results of NRM measurements and subsequent demagnetisation studies are reported here.

ORIGIN OF THE ORE

The occurrence of different ultramafic bodies and their associated rocks in the southern Peninsular India along major planes of weakness suggests that they may represent mantle material injected into the crust. According to Narayanaswamy[3] the ultramafics (including the magnetite concentrations) along NE–SW shear zones in the Eastern Ghats probably represent late tectonic intrusives during the Eastern Ghat Orogeny. According to Karunakaran[2] they are emplaced into the Eastern Ghats prior to the uplift and are older than the enclosing charnockites.

From a study of the field relations and chemical analysis of the ore, Sriramadas[1] deduced that the magnetite ore may be taken as connected with mafic magmas and magmatic looking rocks like gabbros. Minor and trace assemblages of the ore also suggest (Narasayya[5]) an original magmatic origin. The metamorphic episode, after the culmination of Eastern Ghats Orogeny, was placed at 500 Myr (Aswathanarayana[6] and Sarkar[7]).

Collection of Samples

Seven oriented block samples are collected from the exposures in the abandoned mine working. The samples represent the transition zone between the ore and the host rock. The exposures from which the samples are collected are sufficiently close to the surface. As the ore is highly magnetic, the use of a magnetic compass is avoided for directly marking the magnetic North on the samples. The horizontal lines to orient the sample are marked as usual with a spirit level. A rigid rectangular metal frame is placed vertically on the top surface of the exposure and a line determined by its base is marked on the exposure before detaching the block. The line of alignment of the metal frame is measured by a prismatic compass mounted on a tripod and positioned at a distance of 20 metres from the exposure. The measured direction with respect to magnetic North is considered while computing the direction of magnetisation. The error involved in determining the magnetic meridian by this method is less than 2°. From the dimensions of the mine pit, it appears that the mining activity had taken place on a small scale by manual methods The place does not reveal any marks of blast holes

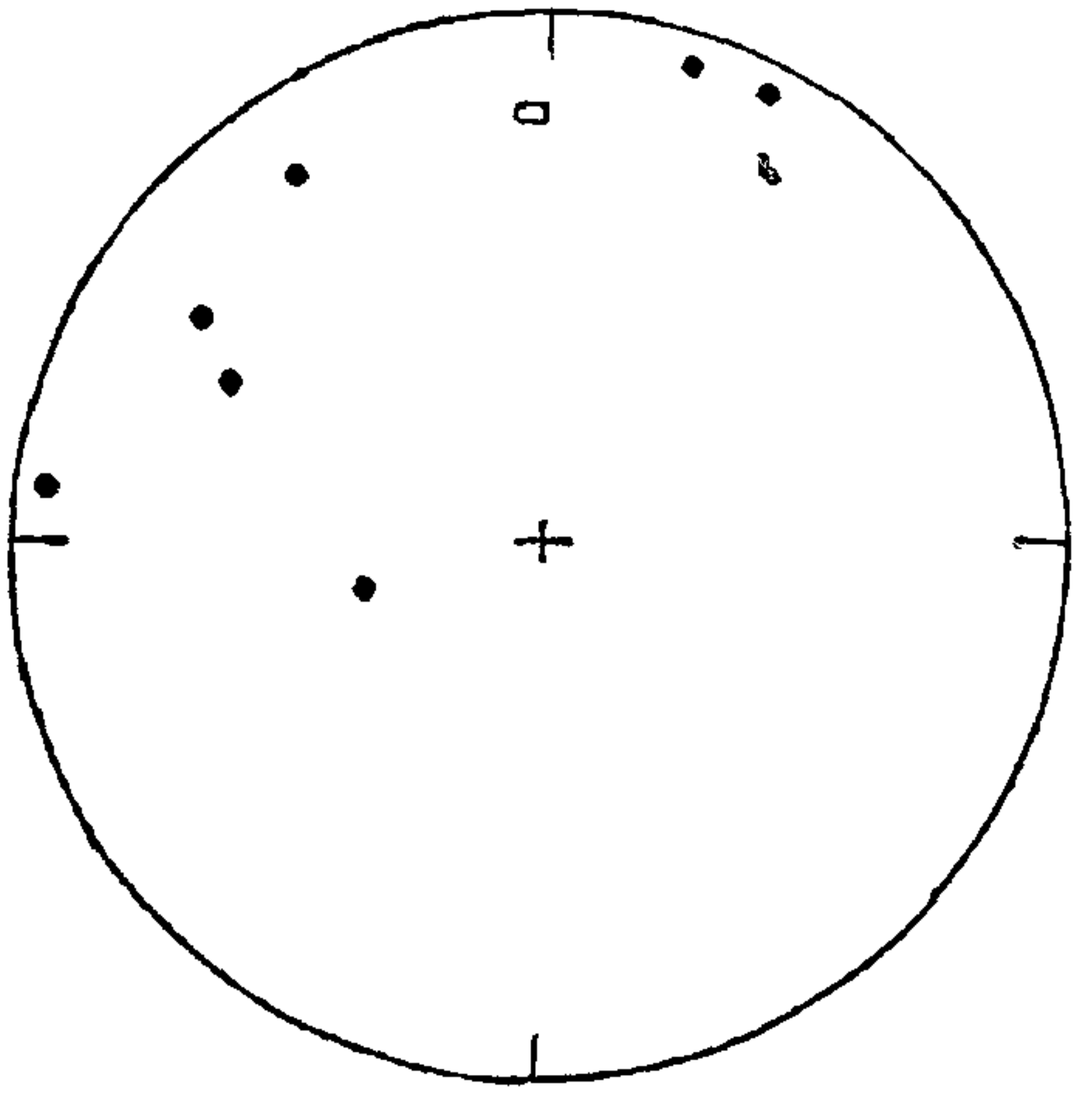


FIG. 1. Sample means of NRM directions.

NRM Measurements and A.C Demagnetisation

From each sample a minimum of two specimens and in all 18 specimens are obtained. The NRM of each specimen (Cylindrical, 2·5 cm long and 2·5 cm dia.) is measured using an astatic magnetometer. The magnetometer has a sensitivity of 1×10^{-6} oe/mm. The direction and intensity of magnetisation are calculated for each specimen and a mean direction for each sample is calculated. The NRM intensities range from $1{\cdot}6 \times 10^{-3}$ e.m.u to $8{\cdot}7 \times 10^{-3}$ e.m.u. The mean directions of samples are projected on a Schmidt equal area net in Fig 1.

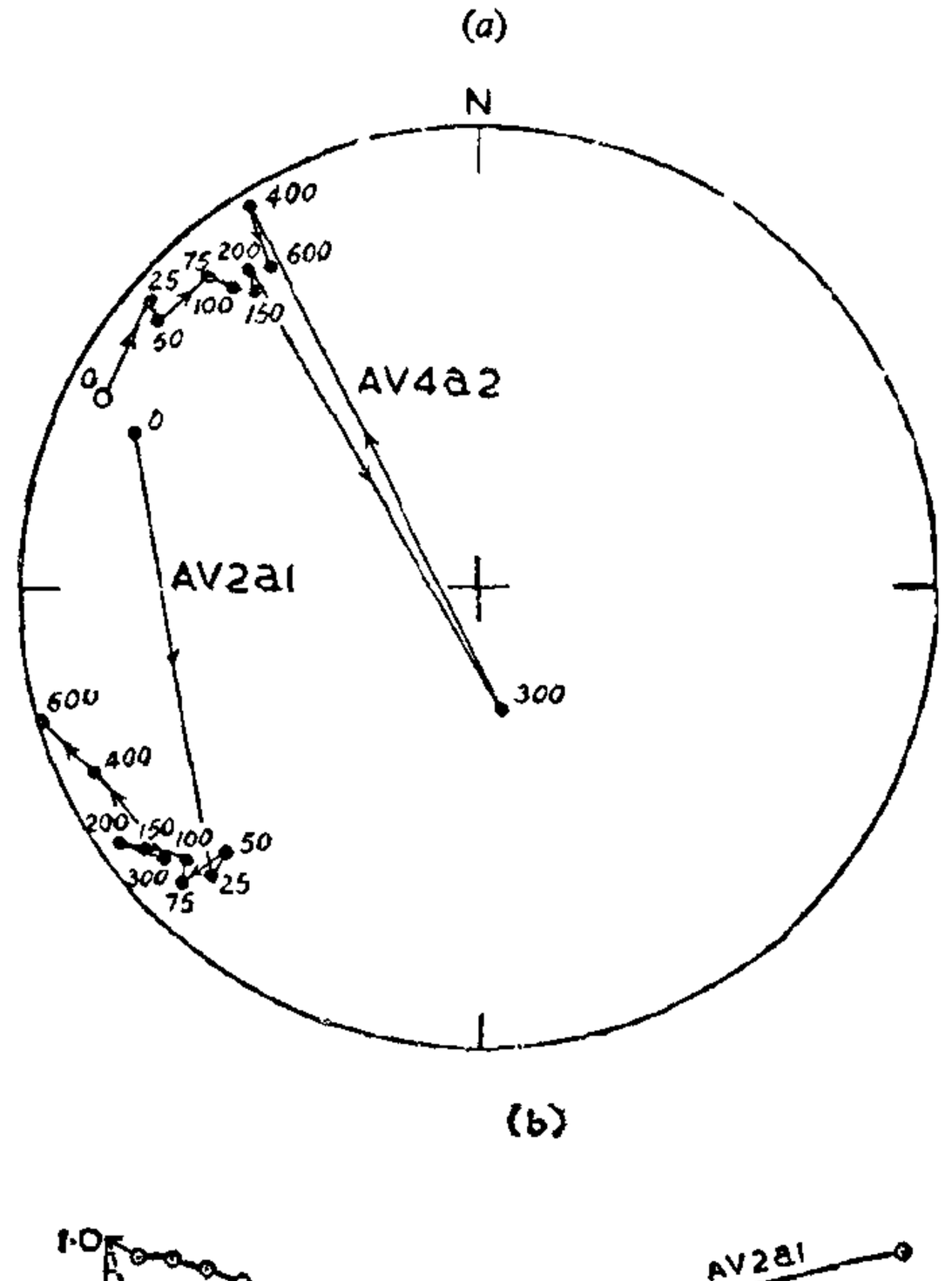


FIG. 2. Effect of A.C. cleaning on pilot specimens.

The specimens are subjected to a.c. demagnetisation to eliminate the secondary components of magnetisation, which are probably causing the scatter of directions in Fig. 1, using the a.c. demagnetisation appa-

ratus at NGRI. The pilot specimens are demagnetised in successively increasing field strengths of 25, 50, 75, 100, 150, 200, 300, 400 and 600 oe. The direction and intensity of magnetisation are measured after each step of demagnetisation. Optimum value of the demagnetising field is determined according to two procedures—one depending on vector rotation of individual directions and another depending on dispersion of directions from several specimens.

The changes in direction of magnetisation, for the two specimens, with field strength are shown in Fig. 2 (*a*). The specimen AV2a1 has undergone relatively small changes in direction between field strengths of 25 oe and 300 oe. In the case of specimen AV4a2 demagnetising fields between 75 and 200 oe have caused small changes in direction. Figure 2 (*b*), which is a plot of normalised intensities against field strength of the same two specimens, shows that the changes in intensity are small beyond a field strength of 250 oe. The behaviour of other pilot specimens is similar to that of the two specimens, illustrated above. All the 18 test specimens are subjected to demagnetisation at three different field strengths, namely, 100, 200 and 300 oe, accompanied by measurements of direction and intensity after each step. Better grouping of vectors is obtained at 100 oe of demagnetising field and the respective mean directions for all the seven samples are calculated and are presented on a Schmidt equal area net in Fig. 3.

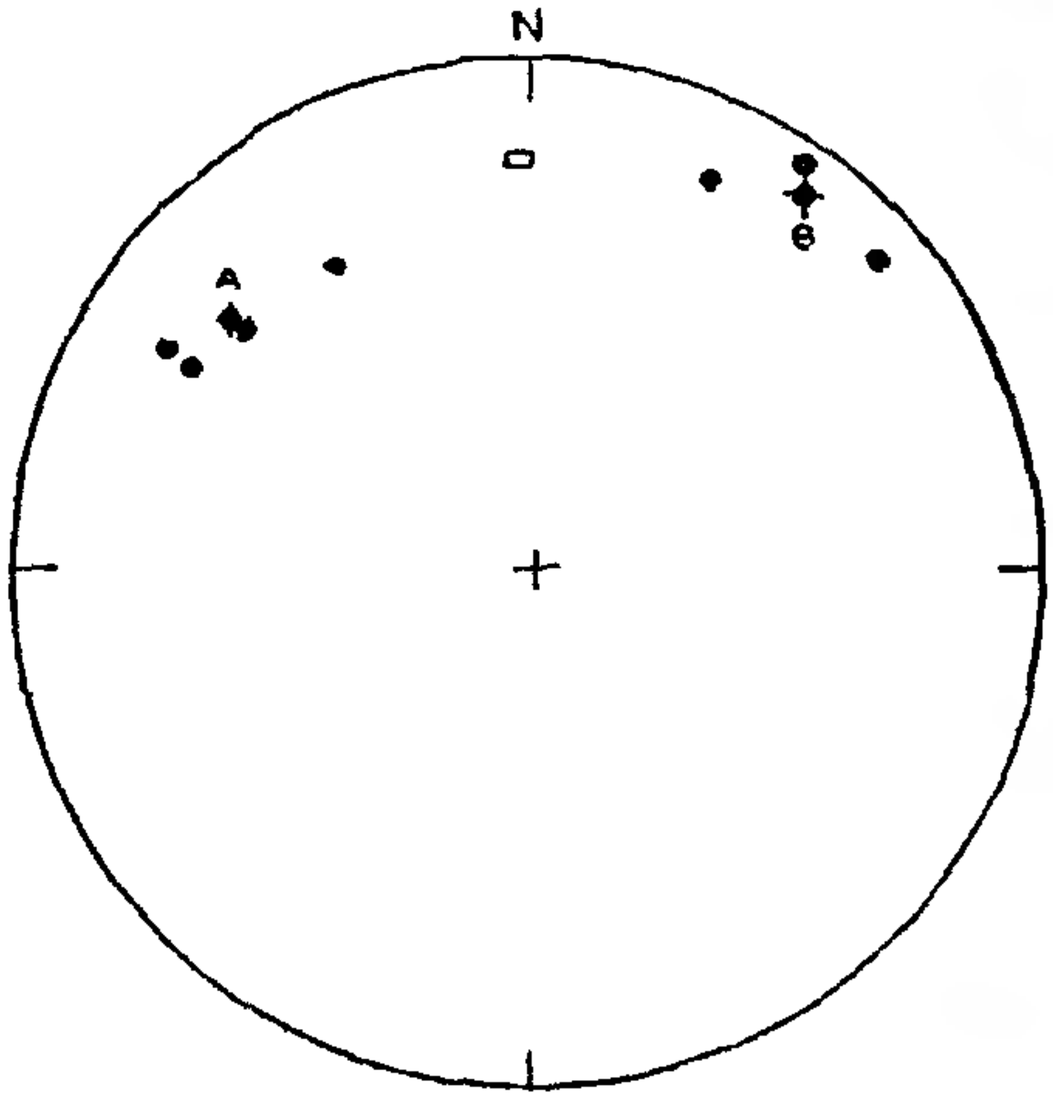
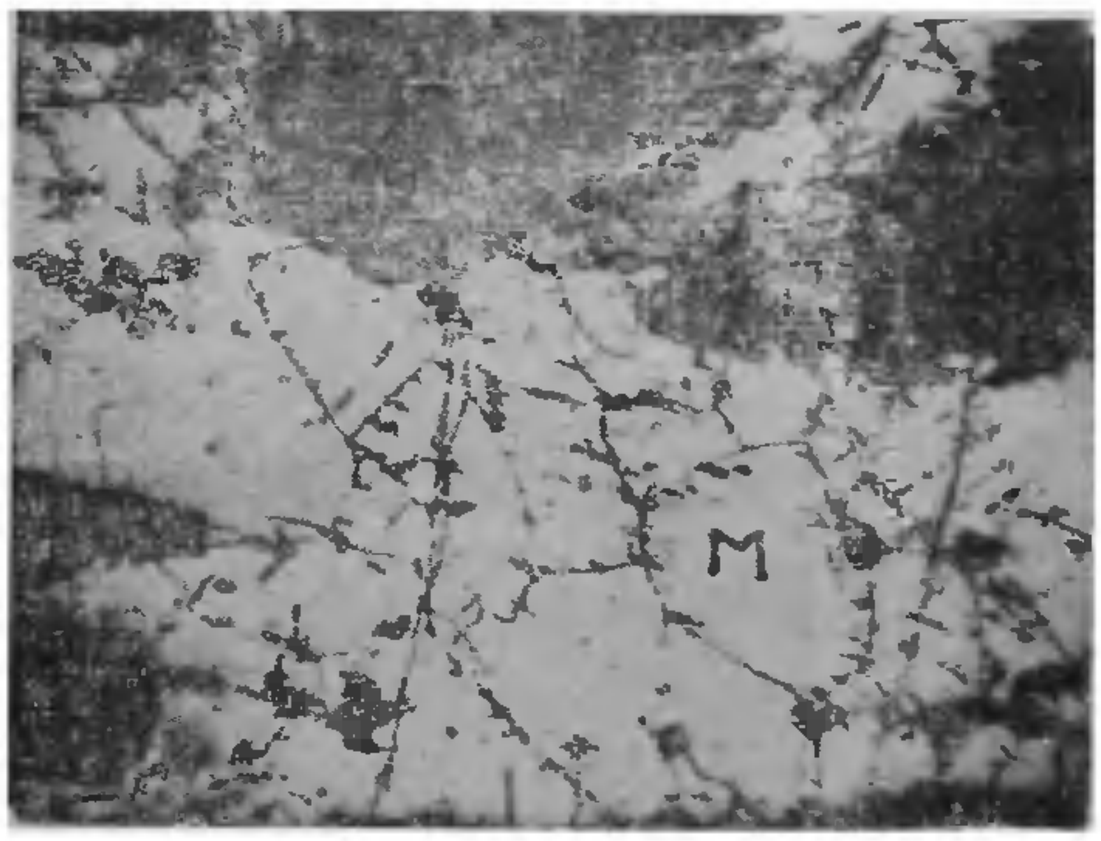


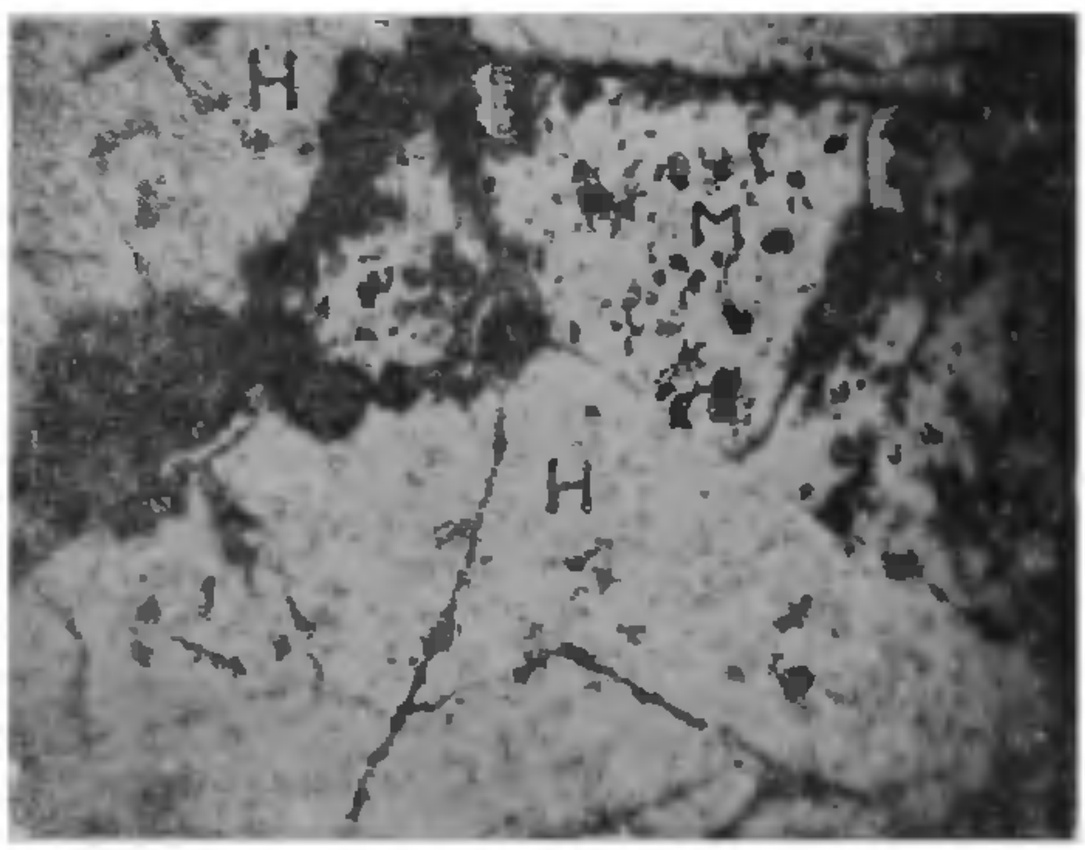
FIG. 3. Sample means after A.C. cleaning.

MINERALOGICAL CHARACTER OF THE SAMPLES

In four samples magnetite represents the major portion and occurs as irregular bands in the host rock. Most of the magnetite grains are unaltered. Exsolved lamellae of ilmenite and spinel are seen in magnetite. The photomicrograph of a polished section is shown in Fig. 4 (*a*). In the remaining three samples, magnetite is found to be extensively martitised and patches of relict magnetite are seen rarely. Haematite is the predominant constituent. Figure 4 (*b*) is a photomicrograph of the polished section of such a sample.



(*a*)



(*b*)

FIG. 4. Photomicrographs of polished sectoins. M—Magnetite, H—Haematite.

DISCUSSION OF RESULTS

The remanent magnetic directions after magnetic cleaning are distributed around two mean directions, A and B (Fig. 3) as compared to the scattered NRM directions in Fig. 1. The two mean directions calculated are A : D = 310° (E), I = + 25° and B : D =

36° (E), I = + 9°. The mean direction A corresponds to samples containing unaltered magnetite as the major constituent while the mean direction B corresponds to the samples in which the magnetite is extensively martitised. the specimens from the two groups show different intensity-decay patterns. This is illustrated in Fig. 5 by presenting the intensity

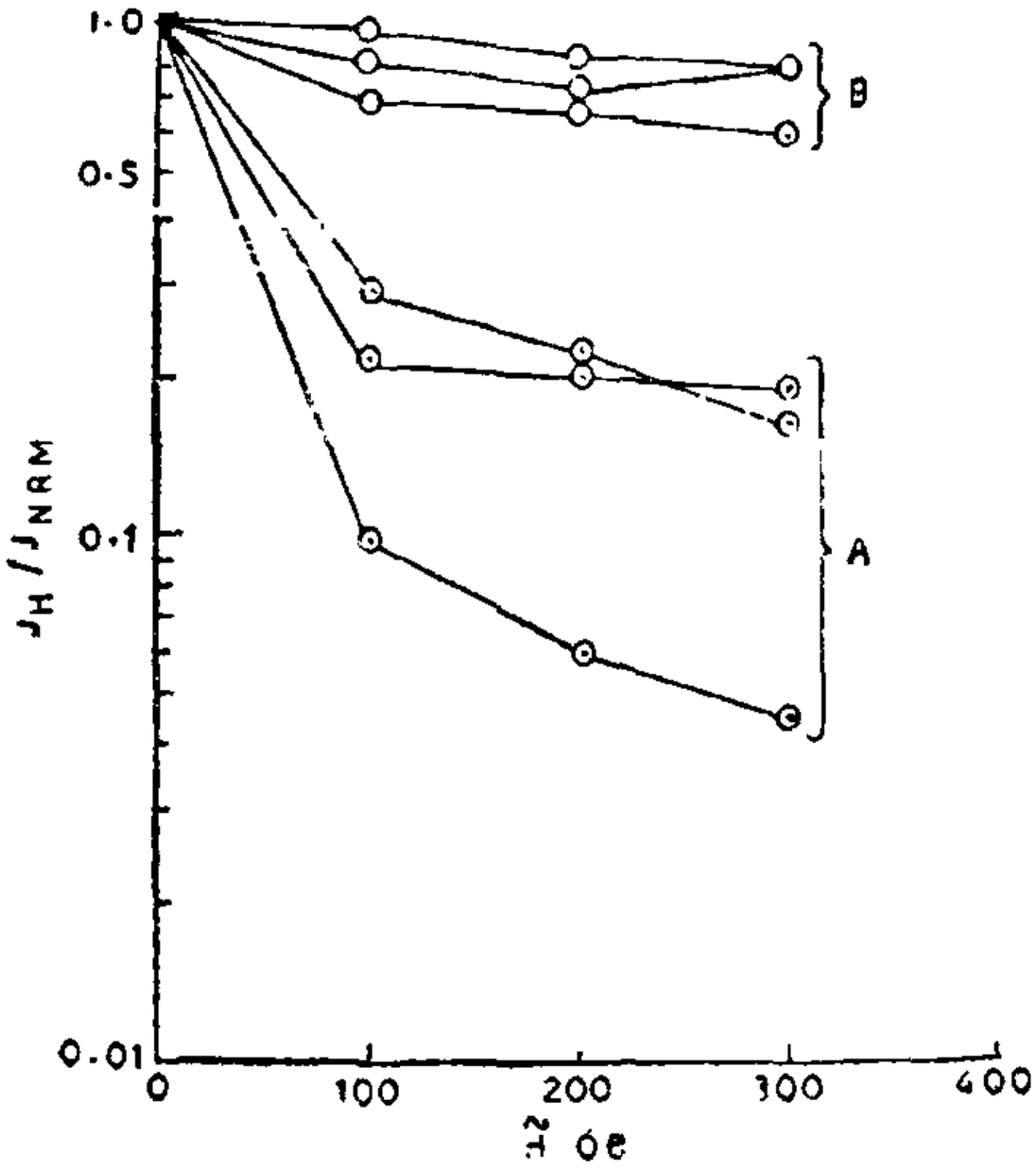


FIG. 5. Intensity decay pattern for three specimens each of Group A and Group B.

decay pattern of three specimens from each group upto a field strength of 300 oe. The decrease in intensity with the field strength is far less for specimens of group B than for group A. The lesser decay in group B may be due to a relatively hard magnetisation controlled by haematite. The mean direction B may be considered to be the effect of martitisation and the mean direction A may be representing the magnetisation controlled by unaltered magnetite.

The pole positions corresponding to the two mean directions A and B are 42° N, 5° W and 52° N, 156° E respectively. These pole positions compare well with those of Veldurti haematites (45° N, 3° E; Verma *et al.*[8]) and Visakhapatnam charnockites (48° N, 152° E; Bhimasankaram[9]). As far as prospecting is concerned, for which purpose the NRM measurements are primarily made, the question, whether the magnetisation was impressed at the time of formation or subsequent to it, in case the ore was metamorphosed, is not serious.

ACKNOWLEDGEMENT

The authors are thankful to the Director, National Geophysical Research Institute, Hyderabad, for providing the facilities for laboratory measurements reported.

1. Sriramadas, A., *Mahadevan Volume*, 1961, p. 130.
2. Karunakaran, C., *Proc. II Symp. U.M.P.*, Hyderabad, 1970, p. 361.
3. Narayanaswamy, S., *Ibid.*, 1970, p. 377.
4. Lakshmipati Raju, A., "Magnetic Studies on some Iron-ore Deposits of Godavari Districts, Andhra Pradesh, India," *Ph.D. Thesis*, Andhra University, Waltair, 1977.
5. Narasayya, B. L., "Mineralogy of Chromite, Magnetite and Apatite Deposits of parts of Eastern Ghats, Andhra Pradesh, India," *Ph.D. Thesis*, Andhra University, Waltair, 1970.
6. Aswathanarayana, U., *Jour Geophys. Res.*, 1964, **69**, 3479.
7. Sarkar, S. N., *Precambrian Stratigraphy and Geochronology of Peninsular India*, Dhanbad Publishers., 1968.
8. Verma, R. K., *et al.*, *Geophys. J.*, 1966, **11**, 499.
9. Bhimasankaram, V. L. S., *Curr. Sci.*, 1964, **33**, 465.